

South Dakota AFNR

Academic Integration Activities: Example #11

→ *Advanced Animal Science students use theoretical probabilities to predict simple genetic outcomes.*

1. Ag Standard

Advanced Animal Science –AN 4.4

Predict genetic outcomes. (Analyzing)

2. Academic Standard

9-12.S.2.2

Students are able to predict outcomes of simple events using given theoretical probabilities.
(Comprehension)

3. Background Information

Where experimental probability relies on using actual data from an experiment, theoretical probability is determined by noting all the possible outcomes theoretically and determining the likelihood of the given outcome.

The formula for theoretical probability of an event is:

$P(\text{event}) = \text{number of favorable outcomes} / \text{number of total outcomes}$

Example: A bag contains 10 red marbles, 8 blue marbles, and 2 yellow marbles. Find the theoretical probability of getting a blue marble.

Solution: There are 8 blue marbles. Therefore, the number of favorable outcomes = 8. There are a total of 20 marbles. Therefore, the number of total outcomes = 20.

$P = 8/20$ which can be expressed as a fraction $2/5$, a ratio 2:5, a percentage 40%, or a decimal 0.4.

4. Example in Context

Assume you have a herd of 200 beef cows. This summer you are using the following bulls:

- > 3 sons of Almighty
- > 2 sons of PowerHouse
- > 2 sons of BeefMaker
- > 1 son of TBone

Predict the probability that a calf next spring will be sired by a son of PowerHouse.

Review the formula.

$P(\text{event}) = \text{number of favorable outcomes} / \text{number of total outcomes}$

Find the total number of outcomes.

8 in this example ($3+2+2+1$)

Find the total number of favorable outcomes (son of PowerHouse).

2 in this example

Therefore, the theoretical probability is $2/8$, which can be reduced to $1/4$. There are different ways to say this: 25%, 0.25 (decimal), or 1:4 (ratio).

5. Guided Practice Exercises

Assume you have a herd of 400 beef cows. Last winter you used the following bulls:

- > 4 sons of MoneyMaker
- > 4 sons of CashCow
- > 2 sons of Awesome
- > 2 sons of BigBoy

Predict the probability that a calf this fall will be sired by a son of CashCow. Express your answer as a ratio.

Answer: $4/12$ reduced to $1/3$. As a ratio, the answer is 1:3.

6. Independent Practice Exercises

Assume you have a herd of 100 beef cows. Last summer you used the following bulls:

- > 2 sons of MoneyMaker
- > 1 son of CashCow
- > 1 son of Awesome

Predict the probability that a calf this spring will be sired by a son of MoneyMaker. Express your answer as a fraction.

Answer: $2/4$ reduced to $1/2$.

Assume you have a flock of 500 ewes. Last fall you used the following rams:

- > 8 sons of #545
- > 4 sons of #22
- > 4 sons of #778
- > 4 sons of #402

Predict the probability that a lamb this spring will be sired by a son of #402. Express your answer as a percentage.

Answer: 4/20 reduced to 1/5. As a percentage, the answer is 20%.

7. Notes

This activity can lead into a discussion about Expected Progeny Differences (EPDs). EPDs use very complex theoretical probabilities to predict the outcome of offspring based on genetic traits.